

## Message Text

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SUBJECT: U.S. PAPER ON PROLIFERATION AND SAFEGUARDS FOR  
WORKING GROUP 7

FULL TEXT OF U.S. PAPER FOLLOWS. TABLES AND REFERENCES, NOT  
ENCLOSED, ARE SAME AS PREVIOUS DRAFT, EXCEPT THAT ORDER OF  
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TABLES IS CHANGED AND TITLE OF ORIGINAL TABLE 1 SHOULD BE  
CHANGED TO: "ESTIMATED COVERSION TIMES."

BEGIN TITLE: PROLIFERATION AND SAFEGUARDS CONSIDERATIONS  
FOR WASTE MANAGEMENT IN THE NUCLEAR FUEL CYCLE. END TITLE.

BEGIN TEXT:

I. INTRODUCTION

"AT THE FEBRUARY 1978 MEETING OF INFCE WORKING GROUP 7, THE UNITED STATES WAS REQUESTED TO PREPARE A BACKGROUND PAPER (FOOTNOTE: THIS PAPER IS NOT NECESSARILY A PART OF THE WORKING GROUP 7 FINAL REPORT. END FOOTNOTE) ON THE PROLIFERATION AND SAFEGUARDS CONSIDERATIONS ASSOCIATED WITH THE STORAGE AND DISPOSAL OF NUCLEAR WASTES. (FOOTNOTE:

NUCLEAR WASTES ARE THOSE MATERIALS WHICH ARE NOT CONSIDERED A USEFUL PART OF A FUEL CYCLE AND HAVE BEEN TRANSFERRED FROM A FACILITY FOR DISPOSAL. THIS INCLUDES SPENT FUEL FOR ALTERNATIVE CYCLES 1 AND 4. END FOOTNOTE). THIS PAPER IS A PRELIMINARY RESPONSE TO THAT REQUEST. IT ATTEMPTS TO DELINEATE SOME IMPORTANT CONSIDERATIONS FOR THE WORKING GROUP 7 TREATMENT OF THE PROLIFERATION AND SAFEGUARDS ASPECTS OF NUCLEAR FUEL CYCLE WASTES. IT DOES NOT ATTEMPT TO PRESENT A COMPREHENSIVE TREATMENT OF THESE SUBJECTS.

"IN ADDRESSING PROLIFERATION AND SAFEGUARDS QUESTIONS, IT IS IMPORTANT TO DRAW AS CAREFUL AS POSSIBLE A DISTINCTION BETWEEN THE ASSESSMENT AND COMPARISON OF THE PROLIFERATION RESISTANCE OF PROPOSED FUEL CYCLES AND THE ANALYSIS OF POSSIBLE SAFEGUARDS TECHNIQUES APPLICABLE TO THOSE FUEL CYCLES. A SECOND OVERALL CONSIDERATION FOR WORKING GROUP 7 UNCLASSIFIED

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IS TO SPECIFY CAREFULLY THE PARTS OF THESE AREAS THAT THIS WORKING GROUP SHOULD ADDRESS.

"ON THE FIRST POINT, WE NOTE THAT SAFEGUARDS ANALYSIS IS CLEARLY A COMPONENT IN THE ASSESSMENT OF PROLIFERATION RESISTANCE, BUT THAT PROLIFERATION ASSESSMENT IS A BROADER QUESTION THAN JUST THE EXAMINATION OF TECHNIQUES FOR MONITORING NUCLEAR MATERIALS OR FACILITIES, THE PROVINCE OF SAFEGUARDS. MOREOVER, JUDGMENTS ABOUT THE RELATIVE PROLIFERATION RESISTANCE OF VARIOUS ALTERNATIVE FUEL CYCLES SHOULD BE BASED ON A COMPARATIVE ANALYSIS OF ENTIRE FUEL CYCLES--NOT OF SINGLE PARTS. SUCH COMPARATIVE ANALYSIS OF PROLIFERATION RISKS ASSOCIATED WITH PROPOSED FUEL CYCLES LIES OUTSIDE THE SCOPE OF WORKING GROUP 7.

"WORKING GROUP 7 DOES HAVE THE RESPONSIBILITY A) TO CHARACTERIZE WASTE MANAGEMENT SYSTEMS AND MATERIALS AS A BASIS FOR THE PROLIFERATION RESISTANCE ASSESSMENTS THAT WILL BE PERFORMED BY GROUPS WHICH HAVE RESPONSIBILITY FOR COMPARING ENTIRE FUEL CYCLES, AND B) TO PERFORM SAFEGUARDS ANALYSES FOR THESE SYSTEMS. BOTH SYSTEM CHARACTERIZATION AND SAFEGUARDS ANALYSIS SHOULD BE PERFORMED FOR THE FIVE ALTERNATIVE FUEL CYCLES THAT WORKING GROUP 5 IS CONSIDERING:

1. LWR WITH SPENT FUEL DISPOSAL
2. LWR WITH REPROCESSING AND PLUTONIUM RECYCLE IN LWR
3. REPROCESSING AND PLUTONIUM RECYCLE IN FBR

4. HWR WITH SPENT FUEL DISPOSAL
5. HWR WITH REPROCESSING

"SECTION II INDICATES HOW WASTE MANAGEMENT SYSTEMS FOR THE FUEL CYCLES BEING CONSIDERED MAY BE CHARACTERIZED, PRIOR TO ANY DETAILED PROLIFERATION RESISTANCE OR SAFEGUARDS

ANALYSIS; IT ALSO PRESENTS SUMMARY ESTIMATES ON FUEL CYCLE WASTE QUANTITIES. BASED ON THESE ESTIMATES, SECTION III  
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CONTAINS PRELIMINARY COMMENTS ON THE SENSITIVITY OF NUCLEAR WASTES. SECTION IV CONTAINS PRELIMINARY COMMENTS ON SAFEGUARDING THESE WASTES.

## II. TECHNICAL DESCRIPTION OF WASTE MANAGEMENT AND DISPOSAL SYSTEMS

"THE VARIOUS WASTE STREAMS DIFFER GREATLY IN THEIR CONTENT AND ACCESSIBILITY OF SENSITIVE MATERIALS. TO PROVIDE A BASIS FOR EVALUATING THE EXTENT TO WHICH THESE WASTE STREAMS MIGHT BE USED FOR RECOVERING SENSITIVE MATERIALS, THE TECHNICAL AND INSTITUTIONAL FEATURES OF THE WASTE MANAGEMENT SYSTEM MUST BE DESCRIBED FOR EACH FUEL CYCLE TO BE EVALUATED AS PART OF INFCE. THIS EVALUATION WILL REQUIRE THE FOLLOWING INFORMATION:

### "1. A DESCRIPTION OF WASTE HANDLING AND STORAGE SYSTEMS

"A FLOWSHEET SHOULD DEFINE THE WASTE HANDLING AND STORAGE SYSTEM IN SUFFICIENT DETAIL TO PERMIT ONE TO DETERMINE WHETHER SIGNIFICANT QUANTITIES OF SENSITIVE MATERIALS ARE LIKELY TO EXIST AT VARIOUS POINTS IN THE WASTE SYSTEM. IT SHOULD SPECIFY THE APPROXIMATE AMOUNTS OF SENSITIVE MATERIALS AND WASTE MATERIALS IN PROCESS, STORED, OR MOVING BETWEEN VARIOUS FACILITIES. THE LENGTHS OF TIME THAT VARIOUS MATERIALS ARE IN PROCESS OR STORED AT ANY FACILITY SHOULD BE GIVEN. ANY PLANS FOR RETRIEVABILITY OF WASTE MATERIALS SENT TO DISPOSAL SHOULD BE IDENTIFIED.

"FOR THE FIVE FUEL CYCLES BEING ANALYZED INITIALLY BY WORKING GROUP 7, IT IS LIKELY THAT, WITH RESPECT TO PROLIFERATION AND SAFEGUARDS CONSIDERATIONS, FUEL CYCLE SIMILARITIES WILL RESULT IN TWO GENERIC FLOWSHEETS. ONE  
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WOULD PERTAIN TO THE TWO SPENT FUEL WASTE CYCLES, AND THE OTHER TO THE THREE CYCLES INVOLVING WASTES FROM REPROCESSING OPERATIONS. BOTH FLOWSHEETS SHOULD DISTINGUISH VARIATIONS IN THE QUANTITIES OF MATERIALS AND LENGTHS OF TIME

INVOLVED IN VARIOUS STEPS OF THE PROCESS.

"2. A DESCRIPTION OF MATERIALS PRESENT IN WASTE STREAMS

"FOR ALL WASTE STREAMS IDENTIFIED AS CONTAINING SIGNIFICANT QUANTITIES OF SENSITIVE MATERIALS, A DESCRIPTION SHOULD BE GIVEN OF THE PHYSICAL FORM, CHEMICAL COMPOSITION, ISOTOPIC COMPOSITION, RADIOACTIVITY, RADIATION LEVEL, AND HEAT LOAD. ALL QUANTITIES SHOULD RELATE TO A COMMON BASIS

SUCH AS MASS OF UNIRRADIATED FUEL SUPPLIED TO A REACTOR OR UNIT OF ELECTRICITY GENERATED:

"-- GIVE A DESCRIPTION OF THE PHYSICAL FORM, INCLUDING THE STRUCTURE, DIMENSIONS, AND WEIGHT OF DISCRETE UNITS, IF ANY. THE WEIGHT AND VOLUME OF DISCRETE UNITS OF SPENT FUEL OR WASTE MATERIAL SHOULD BE DISTINGUISHED FROM THE TOTAL WEIGHT AND VOLUME OF THE DISPOSAL PACKAGE.

"-- GIVE THE CHEMICAL COMPOSITION OF THE COMPOUND OR MATRIX MATERIAL CONTAINING THE WASTE ALONG WITH THE PERCENTAGE COMPOSITION BY WEIGHT OF ACTINIDES AND GROSS FISSION PRODUCTS IN THIS WASTE; INDICATE RELEVANT CHANGES IN COMPOSITION WITH TIME, SUCH AS THOSE CAUSED BY RADIOACTIVE DECAY, HEAT GENERATION, OR RADIATION DAMAGE.

"-- SPECIFY THE ISOTOPIC COMPOSITION OF ALL ACTINIDES AND THEIR CHANGES WITH TIME; FOR INDIVIDUAL FUEL UNITS, INDIVIDUAL WASTE PACKAGES OR WASTE AMOUNTS RELATED TO A COMMON MASS OF UNIRRADIATED FUEL, CHARACTERIZE THE SURROUNDING RADIATION LEVELS BY TYPE OF RADIATION AND DISTANCE AS A FUNCTION OF TIME; SPECIFY THE AMOUNT OF HEAT GENERATED  
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PER UNIT PACKAGE OF WASTE OR SPENT FUEL AS A FUNCTION OF TIME. -

"3. A DESCRIPTION OF FACILITIES USED IN WASTE MANAGEMENT

"FOR FACILITIES USED TO TRANSPORT, STORE, PACKAGE, OR, WHERE NECESSARY, REPACKAGE WASTE MATERIALS, INDICATE THE PROCESSES OCCURRING THROUGHOUT AND THE NATURE OF PROCESS MATERIALS AND EQUIPMENT OF VARIOUS POINTS. DESCRIBE THE CHARACTERISTICS OF REPOSITORIES SELECTED FOR BOTH RETRIEVABLE AND ULTIMATE DISPOSAL OF WASTES. INCLUDE SUFFICIENT DETAILS ABOUT EXCAVATING, FILLING, AND SEALING SUCH REPOSITORIES TO PERMIT AN ANALYSIS OF THE TYPE OF SAFEGUARDING REQUIRED, BOTH DURING THE PERIOD OF TIME THE REPOSITORY IS STILL BEING FILLED AND AFTER IT HAS BEEN FILLED, SEALED, AND DECOMMISSIONED.

PRELIMINARY SUMMARY OF FUEL CYCLE FACILITIES AND WASTES:

"IT IS USEFUL FOR PURPOSES OF THIS PAPER TO SUMMARIZE THE ESTIMATED WASTE ARISING FROM THE NUCLEAR FUEL CYCLE. TABLE I LISTS THE PRINCIPAL SEGMENTS OF THE VARIOUS FUEL CYCLES, AND SHOWS THE GENERIC WASTE TYPES THAT ARE EXPECTED TO BE GENERATED IN EACH SEGMENT OF THE FUEL CYCLE. IT ALSO GIVES AN ESTIMATE OF THE QUANTITIES OF SENSITIVE NUCLEAR MATERIAL DISCARDED TO WASTE AS A PERCENT OF PROCESS THROUGHPUT.

### III. PRELIMINARY COMMENTS ON THE AMOUNT AND ACCESSIBILITY OF SENSITIVE MATERIALS IN WASTES

"ON THE BASIS OF THE ESTIMATES GIVEN IN TABLE I, WE MAKE SOME PRELIMINARY OBSERVATIONS ON THE PROLIFERATION SENSITIVE WASTES.

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TIVITY OF FUEL CYCLE WASTES, PRIMARILY TO INDICATE WHERE IMPROVED SAFEGUARDS MAY BE NEEDED, AND ALSO TO SUGGEST HOW WASTE-RELATED RISKS COMPARE WITH THOSE FROM OTHER ASPECTS OF THE FUEL CYCLE.

"DOUBLE LINES DIVIDE TABLE I INTO THREE WASTE CATEGORIES: WASTE MATERIAL GENERATED BY FACILITIES HANDLING ONLY NATURAL AND LOW-ENRICHED URANIUM (LEU) WOULD REQUIRE ISOTOPIC ENRICHMENT AS WELL AS CHEMICAL AND PHYSICAL CHANGES TO BE SUITABLE FOR USE IN A NUCLEAR EXPLOSIVE. IN OTHER NUCLEAR FUEL CYCLE FACILITIES THE CONCENTRATIONS OF FISSILE MATERIAL IN PROCESS STREAMS CAN BE RELATIVELY HIGH; BUT THE WASTES FROM THESE FACILITIES WOULD REQUIRE PURIFICATION TO REMOVE HIGHLY RADIOACTIVE FISSION PRODUCTS. A THIRD CATEGORY OF WASTES WOULD NOT REQUIRE EITHER ISOTOPIC SEPARATION OR PURIFICATION TO REMOVE FISSION PRODUCTS, BUT THE CONCENTRATIONS OF FISSILE MATERIAL ARE SO LOW THAT LARGE AMOUNTS OF WASTE WOULD HAVE TO BE CHEMICALLY SEPARATED TO OBTAIN SIGNIFICANT QUANTITIES OF NUCLEAR MATERIAL.

"IN GENERAL, WASTES CONTAINING DEPLETED NATURAL OR LOW-ENRICHED URANIUM ARE LESS ATTRACTIVE FOR DIVERSION THAN PROCESS STREAMS CONTAINING THESE MATERIALS. THIS WASTE WOULD REQUIRE ISOTOPIC ENRICHMENT AS WELL AS CHEMICAL AND PHYSICAL CHANGES TO BE MADE SUITABLE FOR USE IN A NUCLEAR EXPLOSIVE. MOREOVER, ONLY A FRACTION OF A PERCENT OF THE URANIUM THROUGHPUT ENDS UP IN WASTE, THUS FURTHER DECREASING THE ATTRACTIVENESS OF WASTE MATERIAL. ACCORDINGLY, THIS TYPE OF WASTE WOULD BE AN UNLIKELY CHOICE FOR DIVERSION COMPARED TO PROCESS STREAMS CONTAINING SIMILAR MATERIALS.

"HIGHLY RADIOACTIVE SPENT FUEL AND REPROCESSING PLANT WASTES ARE SOMEWHAT SELF-PROTECTING BECAUSE OF INHERENT

HANDLING DIFFICULTIES. COMPARISON OF SPENT FUEL AND HIGH  
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LEVEL WASTE (BOROSILICATE GLASS) FROM REPROCESSING INDICATES THAT THE CONCENTRATION OF PLUTONIUM IS ABOUT A FACTOR OF FORTY GREATER IN THE SPENT FUEL. THUS, SPENT FUEL IS A MUCH MORE ATTRACTIVE SOURCE FOR OBTAINING PLUTONIUM THAN ARE REPROCESSING WASTES. THESE WASTES CONTAIN OTHER TRANSURANIC ELEMENTS (FOOTNOTE: THE CONCENTRATIONS OF CERTAIN TRANSURANIC ELEMENTS MAY BE COMPARABLE TO THE PLUTONIUM IN SOME REPROCESSING WASTE. END FOOTNOTE), SUCH AS NEPTUNIUM AND AMERICIUM, BUT IT DOES NOT NOW APPEAR THAT THESE WILL CONSTITUTE A SIGNIFICANT ALTERNATE SOURCE OF SENSITIVE MATERIAL. IN THE LONG TERM AND IN THE ABSENCE OF REPROCESSING, LARGE INVENTORIES OF SPENT FUEL CAN BE EXPECTED IN PERMANENT DISPOSAL AND/OR IN RECOVERABLE STORAGE. TO A MUCH LESSER EXTENT, SENSITIVE MATERIALS WOULD BE PRESENT IN THE HIGH LEVEL WASTE FROM REPROCESSING WHICH WOULD ALSO BE IN PERMANENT DISPOSAL AND/OR RECOVERABLE STORAGE. THE DEGREE OF PERMANENCY OF DISPOSAL OR THE PROTECTION AFFORDED BY HIGH RADIOACTIVITY AS A FUNCTION OF TIME MUST BE ESTIMATED FOR USE IN COMPARING THE PROLIFERATION RESISTANCE OF PROPOSED FUEL CYCLES. IN DOING SO, IT IS NECESSARY TO CONSIDER WHETHER DEVELOPMENT OF ADVANCED RECOVERY TECHNIQUES MIGHT ALLOW RAPID AND EASY REMOVAL OF HIGH ACTIVITY MATERIAL FROM WHAT TODAY MAY BE PERCEIVED AS UNRETRIEVABLE DISPOSAL OR WHETHER NEW TECHNOLOGY COULD ALSO MAKE SECONDARY RECOVERY OF SENSITIVE MATERIALS FROM HIGH LEVEL WASTE ATTRACTIVE (NOT ONLY FOR POTENTIAL PROLIFERATION BUT ALSO FOR FUEL CONTENT).

"NORMALLY, THE WASTE FROM CONVERSION AND FABRICATION OF MIXED OXIDE FUEL CONTAINS VERY LOW CONCENTRATIONS OF PLUTONIUM AND, IN THE CASE OF FABRICATION, LOW-ENRICHED, NATURAL OR DEPLETED URANIUM. ALTHOUGH THESE WASTES DO  
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NOT REQUIRE PURIFICATION TO REMOVE FISSION PRODUCTS, LARGE AMOUNTS OF WASTE WOULD HAVE TO BE PROCESSED TO OBTAIN SIGNIFICANT QUANTITIES OF SENSITIVE MATERIAL. BECAUSE IT DOES NOT NOW APPEAR ECONOMICAL TO RECOVER THE SENSITIVE MATERIAL FROM CONVERSION AND FABRICATION WASTE, THE NEAR-TERM PROLIFERATION CONCERN SEEMS RELATIVELY LOW.

"OF THESE WASTES, IT IS CLEAR THAT DISPOSED SPENT FUEL WOULD CONSTITUTE THE MOST USEFUL SOURCE OF MATERIAL FOR WEAPONS USE. THE INFLUENCE OF THIS ON PROLIFERATION RESISTANCE, HOWEVER, DEPENDS ON ITS ACCESSIBILITY AND ON THE DIFFICULTY OF RETRIEVING AND PROCESSING FUEL RELATIVE

TO OTHER PROLIFERATION ROUTES. TO THE EXTENT THAT THESE AND OTHER WASTES ARE RETRIEVABLE AND USEFUL, ADEQUATE SAFEGUARDS MUST BE PROVIDED.

#### IV. SAFEGUARDS ASPECTS OF WASTES MANAGEMENT SYSTEMS

(BEGIN SUBHEADING) GENERAL CONSIDERATIONS IN SAFEGUARDING NUCLEAR FACILITIES (END SUBHEADING)

"THE IAEA HAS DEFINED THE OBJECTIVES OF INTERNATIONAL SAFEGUARDS AS "THE TIMELY DETECTION OF DIVERSION OF SIGNIFICANT

QUANTITIES OF NUCLEAR MATERIAL FROM PEACEFUL NUCLEAR ACTIVITIES... AND DETERRENCE OF SUCH DIVERSION BY THE RISK OF EARLY DETECTION." (1) MOREOVER, WITHIN THE INTERNATIONAL COMMUNITY THERE IS GENERAL AGREEMENT ON THE MEANING OF "SIGNIFICANT QUANTITIES" AND EXISTING SAFEGUARDS PRACTICES WHICH INVOLVE PERIODIC INVENTORY VERIFICATION AND CONTAINMENT/SURVEILLANCE OF NUCLEAR MATERIAL.

"CURRENT GUIDELINES FOR TIMELINESS USED BY THE IAEA ARE RELATED TO THE ESTIMATED TIMES REQUIRED TO CONVERT THE DIVERTED MATERIAL TO MATERIAL SUITABLE FOR THE MANUFACTURE OF NUCLEAR EXPLOSIVE DEVICES. CONVERSION TIME UNCLASSIFIED

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ESTIMATES ARE GIVEN IN TABLE II.

"THE NUCLEAR MATERIALS OF CONCERN IN SAFEGUARDS ARE SENSITIVE WEAPONS-USABLE FISSIONABLE MATERIALS (U-233, U-235, AND PLUTONIUM). A "SIGNIFICANT QUANTITY" IS UNDERSTOOD BY THE IAEA TO BE 8 EFFECTIVE KILOGRAMS OF PLUTONIUM OR URANIUM-233, AND 25 EFFECTIVE KILOGRAMS OF URANIUM-235. (SEE FOOTNOTE)

FOOTNOTE: ACCORDING TO REFERENCE (1), "THE QUANTITY IN 'EFFECTIVE KILOGRAMS' IS OBTAINED BY TAKING:

(A) FOR PLUTONIUM, ITS WEIGHT IN KILOGRAMS;

(B) FOR URANIUM WITH AN ENRICHMENT OF 0.01 (1 PERCENT) AND ABOVE, ITS WEIGHT IN KILOGRAMS MULTIPLIED BY THE SQUARE OF ITS ENRICHMENT;

(C) FOR URANIUM WITH AN ENRICHMENT BELOW 0.01 (1 PERCENT) AND ABOVE 0.005 (0.5 PERCENT), ITS WEIGHT IN KILOGRAMS MULTIPLIED BY 0.0001; AND

(D) FOR DEPLETED URANIUM WITH AN ENRICHMENT OF 0.005 (0.5 PERCENT) OR BELOW, AND FOR THORIUM, ITS WEIGHT IN KILOGRAMS MULTIPLIED BY 0.00005." (END FOOTNOTE)

(BEGIN SUBHEADING UNDER IV) SAFEGUARDS FOR NUCLEAR WASTES  
(END SUBHEADING)

"IN GENERAL, THE PRINCIPAL TECHNIQUE IN USE FOR INTERNATIONAL SAFEGUARDING OF WASTE IS ITEM ACCOUNTABILITY, SUPPLEMENTED BY MEASUREMENT OR CALCULATION OF FISSIONABLE CONTENT AND, IN SOME CASES, CONTAINMENT AND SURVEILLANCE.  
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BECAUSE MOST FUEL CYCLE WASTE FORMS ARE, IN THE NEAR TERM, RELATIVELY UNATTRACTIVE SOURCES OF MATERIAL FOR WEAPONS, SIMPLER TECHNIQUES THAN THOSE USED FOR MOST OF THE FUEL CYCLE MAY BE ADEQUATE FOR MOST WASTE FORMS. HOWEVER, FOR

FUEL CYCLE WASTES, THE TIME FRAME OF INTEREST IS GOVERNED BY THE LONG HALF-LIVES OF SENSITIVE MATERIALS, AND IT FOLLOWS THAT SAFEGUARDS CONCERNS MAY EXTEND FOR AN UNUSUALLY LONG PERIOD (HUNDREDS OF YEARS).

"FOR THE THREE CATEGORIES OF WASTES DISCUSSED IN SECTION III THE FOLLOWING PRELIMINARY COMMENTS ON SAFEGUARDS MAY BE MADE:

"1. FOR WASTES CONTAINING DEPLETED, NATURAL, OR LOW-ENRICHED URANIUM, VERIFICATION OF ROUTINE NATIONAL ACCOUNTANCY, CONSISTENT WITH FACILITY MATERIAL BALANCE PROCEDURES, SHOULD BE SUFFICIENT.

"2. FOR SPENT FUEL, ITEM IDENTIFICATION AND PERTINENT STATISTICAL MEASUREMENTS SHOULD BE CONSIDERED TO PREVENT COUNTERFEITING OR ITEM SUBSTITUTION. INTERNATIONAL SAFEGUARDING OF REPROCESSING WASTE CONTAINING SIGNIFICANT QUANTITIES OF SENSITIVE MATERIAL SHOULD INCLUDE FACILITY CONTROL, CONTAINMENT AND SURVEILLANCE, AND MONITORING OF WASTE DISPOSAL FACILITIES.

"3. FOR WASTES FROM MIXED-OXIDE CONVERSION AND FABRICATION, ROUTINE FACILITY MATERIAL BALANCE PROCEDURES, SUPPLEMENTED BY METHODS TO VERIFY SENSITIVE-MATERIAL CONTENT OF WASTE STREAMS, SHOULD AFFORD SUFFICIENT SAFEGUARDS FOR THE NEAR TERM. HOWEVER, IN THE LONG TERM, IMPROVEMENTS IN RECOVERY TECHNIQUES MIGHT MAKE REWORK OF CERTAIN WASTES PRACTICAL, AND MORE EXTENSIVE SAFEGUARDS TECHNIQUES MAY BE REQUIRED.

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## V. SUMMARY

"TWO MAJOR RESPONSIBILITIES THAT WORKING GROUP 7 SHOULD



UNDERTAKE ARE TO CHARACTERIZE WASTE MANAGEMENT SYSTEMS AS A BASIS FOR PROLIFERATION RESISTANCE ASSESSMENT AND TO PERFORM SAFEGUARDS ANALYSES FOR THESE SYSTEMS. THIS PAPER HAS INDICATED HOW SYSTEMS AND MATERIALS MAY BE CHARACTERIZED. IT HAS ALSO GIVEN ESTIMATES OF WASTE ARISINGS, INDICATED THE ASSOCIATED PROLIFERATION CONSIDERATIONS, AND SUGGESTED OVERALL APPROACHES FOR SAFEGUARDING VARIOUS FUEL-CYCLE WASTES.

"NATURAL, OR LOW-ENRICHED URANIUM WASTES ARE A SMALL FRACTION OF THE THROUGHPUT OF CONVERSION, ENRICHMENT, AND LEU-FABRICATION FACILITIES, AND WOULD NEED TO BE ENRICHED OR IRRADIATED TO OBTAIN WEAPONS-USABLE MATERIAL.

A SIGNIFICANT DIVERSION WOULD INVOLVE AT LEAST SEVERAL TONS OF OXIDE.

"DISPOSAL OF SPENT FUEL, WHEN COMPARED TO HIGH-LEVEL WASTE FROM REPROCESSING, PRESENTS GREATER CONCERN FOR BOTH NEAR-TERM AND LONG-TERM PROLIFERATION RESISTANCE AND SAFEGUARDS. IN THE NEAR TERM, EFFECTIVE MATERIAL BALANCE AND ACCOUNTANCY, AND SURVEILLANCE AND CONTAINMENT SHOULD BE USED FOR SAFEGUARDING SPENT FUEL AND HIGH-LEVEL WASTE. LONG-TERM SAFEGUARDS REQUIREMENTS ARE IN GENERAL DIFFICULT TO PREDICT BECAUSE OF POSSIBLE TECHNOLOGICAL, POLITICAL, AND INSTITUTIONAL CHANGES. HOWEVER, BECAUSE OF THE LONG-LIVED MATERIALS INVOLVED, LONG-TERM SAFEGUARDS NEEDS HAVE TO BE ADDRESSED FOR NUCLEAR WASTES.

"WASTES FROM PLUTONIUM CONVERSION AND MOX FUEL FABRICATION  
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ARE OF LOW FISSILE CONCENTRATION, BUT THESE WASTE STREAMS COULD PROVIDE A PATH FOR DIVERSION. ROUTINE FACILITY MATERIAL BALANCE PROCEDURES SUPPLEMENTED BY METHODS TO VERIFY SENSITIVE MATERIAL CONTENT OF WASTE STREAMS SHOULD AFFORD SUFFICIENT SAFEGUARDS.

"FROM THIS PRELIMINARY TREATMENT, WE CONCLUDE THAT SPENT FUEL WOULD BE THE MOST ATTRACTIVE DIVERSION TARGET AMONG FUEL-CYCLE WASTES, AND THAT THIS FORM THEREFORE DESERVES THE PRINCIPLE ATTENTION OF WORKING GROUP 7, AS FAR AS SAFEGUARDS IS CONCERNED. HOWEVER, THE SIGNIFICANCE OF THIS FOR PROLIFERATION RISK CAN ONLY BE DETERMINED IN THE CONTEXT OF A FULL FUEL CYCLE PROLIFERATION RESISTANCE ASSESSMENT, WHICH WOULD, FOR EXAMPLE, COMPARE THE DIFFICULTIES OF USING DISPOSED SPENT FUEL (IN A ONCE-THROUGH CYCLE) WITH THOSE OF USING EXTRACTED PLUTONIUM (IN A RECYCLE SYSTEM). WORKING GROUP 7 SHOULD, IN ADDITION TO PERFORMING ANALYSIS OF SAFEGUARDS MEASURES, SUPPLY THE INFORMATION ON WASTE MANAGEMENT SYSTEMS REQUIRED FOR SUCH FUEL-CYCLE COMPARISONS. " (END TEXT)

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